

# August 2004 NC Weather Review

## Overview

Four tropical systems impacted North Carolina during August 2004; Alex, Bonnie, Charley, and Gaston. Hurricane Alex affected the Outer Banks during the first of the month. The remnants of Bonnie and Charley brought severe weather including heavy rain, strong winds, and several tornadoes to the eastern half of the state in the middle of the month. Finally, the remnants of Gaston and its associated misery moved through the center of the state during the last week of August. These tropical systems produced above normal rainfall over central and eastern North Carolina during August 2004. Many sites recorded over 10 inches of rain, with Longwood (Brunswick County) topping all stations with over 16 inches of rainfall. Raleigh endured its 4<sup>th</sup> wettest August on record with 9.26 inches of rain. Heavy rainfall associated with these tropical systems produced several flash floods and resulted in minor to moderate river flooding across portions of North Carolina. Figure 1 depicts observed versus the normal rainfall for selected locations across North Carolina during August 2004.

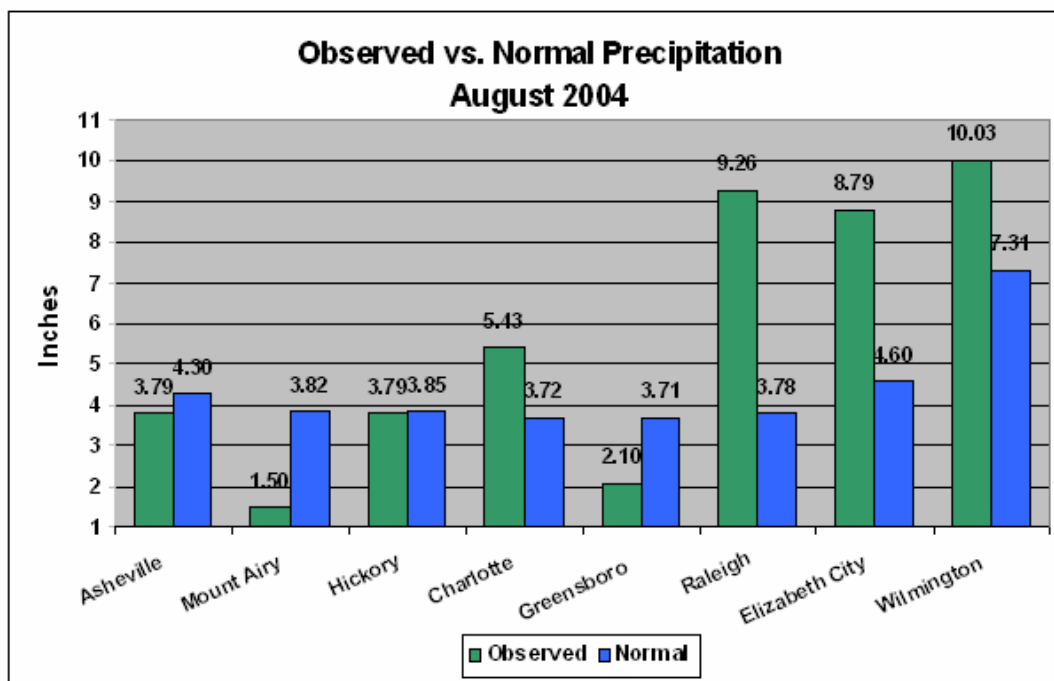


Figure 1 Monthly precipitation reports vs. normal rainfall for August 2004 at selected locations across North Carolina.

With all the clouds and rain, temperatures during August 2004 averaged below normal across the entire state. The central and eastern sections averaged 2 to 4 degrees below normal, while western North Carolina averaged 1 to 2 degrees below normal. There were no prolonged periods of hot weather during August with only a handful of 90 degree days recorded. In between the wet tropical systems, there was a significant cool wave during the first half of the month. Lows during this period bottomed out in the upper 40s and 50s, and there were several record lows set on August 7-8. This cool spell was followed by a wet period which maintained the trend of below normal temperatures for the rest of the month.

Figures 2 and 3 highlight the daily temperatures at both Raleigh-Durham and Greensboro. Note the significant cool period August 6-20, where temperatures averaged much below the 30 year normal.

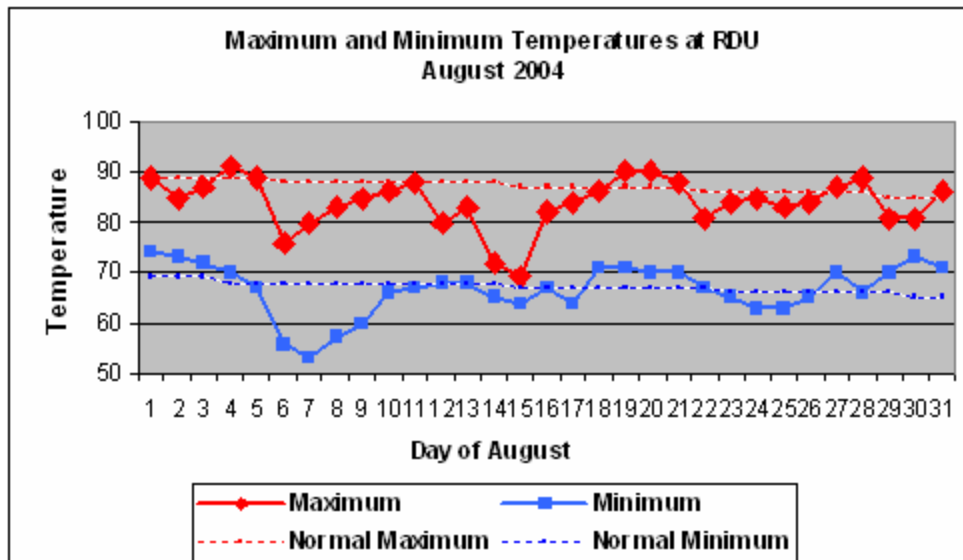


Figure 2 Daily maximum and minimum temperatures observed at Raleigh-Durham (RDU).

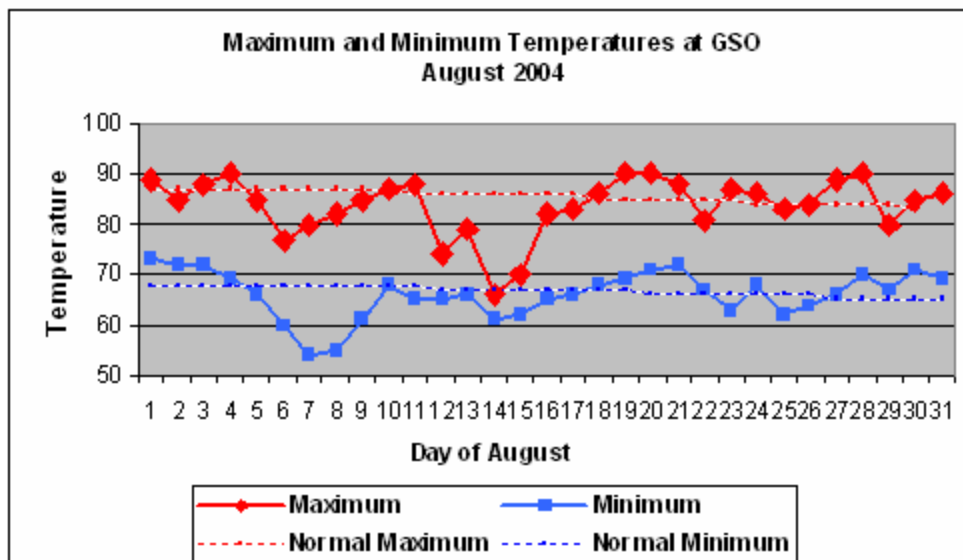


Figure 3 Daily maximum and minimum temperatures observed at Greensboro (GSO).

# Details

## Precipitation

The wettest conditions in August were found over central and eastern North Carolina. Much of the rainfall was either directly or indirectly related to the four tropical systems that affected the state during the month. Rainfall totals over central and eastern North Carolina ranged between 6 and 12 inches, which is approximately 150 to 200 percent of normal. There were numerous stations that recorded rainfall amounts in excess of 10 inches including: Longwood (Brunswick County), 16.30 inches; Clayton (Johnston County), 13.35 inches; Roanoke Rapids (Halifax County), 12.09 inches; Laurinburg (Scotland County), 10.08 inches; Apex (Wake County), 11.10 inches; North Raleigh (Wake County), 10.33 inches; Erwin (Harnett County), 10.39 inches; and Elizabethtown (Bladen County), 10.50 inches.

In the west, the rainfall distribution over the Mountains, Foothills, and western Piedmont was not directly influenced by the tropical systems. Thus, a more typical late summer rainfall distribution pattern was found over the western third of the state. Due to the scattered nature of summer thunderstorms, rainfall patterns were highly variable. The driest locations included: Danbury (Stokes County), 1.30 inches; Mount Airy (Surry County), 1.50 inches; Boone (Watauga County), 2.00 inches; Franklin (Macon County), 2.10 inches; and Greensboro (Guilford County), 2.10 inches. The variability of the rainfall pattern is evident from reports at these locations: Winston-Salem (Forsyth County), 7.50 inches; Pisgah Forest (Buncombe County), 9.60 inches; Turnersburg (Iredell County), 8.04 inches; and Dobson (Surry County), 4.64 inches.

Figure 4 depicts the rainfall totals for North Carolina for August 2004. The map is based on actual rainfall reports from National Weather Service Cooperative Observers and other official observing sites.

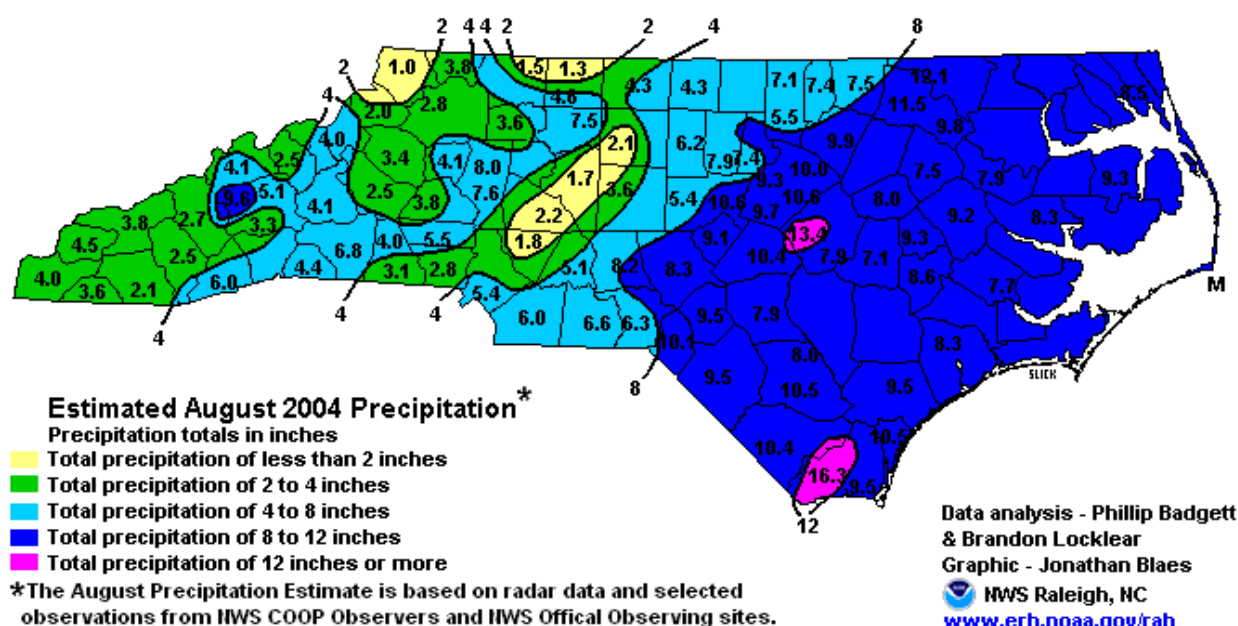


Figure 4 Estimated precipitation during August 2004.

## Temperatures

A dry and cool spell of weather followed Hurricane Alex's visit to North Carolina late in the first week of August. This pattern was very unusual for mid-summer. The last week in July, and the first week of August are typically the hottest weeks of the year across North Carolina.

Several daily record lows were set between August 6<sup>th</sup> and August 8<sup>th</sup>. They included: Charlotte 50 degrees on the 7<sup>th</sup>, Raleigh 56 degrees on the 6<sup>th</sup>, and Wilmington 59 degrees on the 8<sup>th</sup>. Mount Airy and Asheville fell to 46 and 49 degrees respectively on August 8<sup>th</sup>. These temperatures were not records for the date.

With the strong cool spell during the first 10 days of the month followed by the tropical systems, temperatures struggled to reach 90 degrees in August. Greensboro and Charlotte reached 90 degrees only 4 times; while Raleigh and Elizabeth City each hit 90 degrees only on 3 days. Over and near the mountains; Asheville, Boone, and Mount Airy did not reach 90 degrees during the month.

The clouds, increased humidity, and enhanced rainfall during the last few weeks of the month continued the trend of below normal daily temperatures. By months end, the monthly temperature departures from normal included: Charlotte 4.4 degrees below normal, Elizabeth City 2.6 degrees below normal, Wilmington 2.5 degrees below normal, Raleigh 1.9 degree below normal, Greensboro 1.3 degree below normal, and Asheville 1.3 degrees below normal.

## Tropical Cyclones That Affected the State During August 2004

Hurricane Alex was the first of 4 tropical systems which affected the state during August. Alex moved northeast along the Gulf Stream waters off South Carolina toward the Outer Banks of North Carolina on August 3<sup>rd</sup>. The center of the minimal hurricane passed just east of Ocracoke and Cape Hatteras, and wind gusts reached hurricane force along portions of the coastal area and Outer Banks. Figure 5 is a plot of the maximum wind gusts associated with Hurricane Alex. The strongest winds were found at locations closest to the track of the center of the storm.

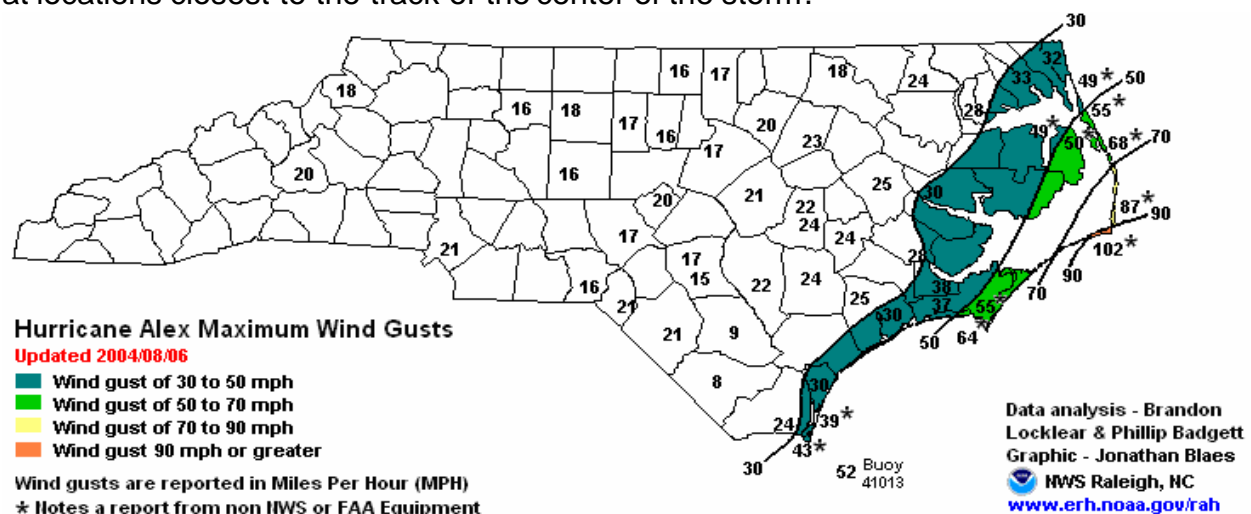


Figure 6 Maximum Wind Gusts Associated with Hurricane Alex, August 3, 2004.

The remnants of Hurricanes Bonnie and Charley were next in line to affect the state in rapid fashion. They directly impacted the state during August 13<sup>th</sup> and 14<sup>th</sup>. Indirect effects of both systems, including severe thunderstorms, flash flooding, and isolated tornadoes were felt over various portions of the state August 12<sup>th</sup> through August 15<sup>th</sup>. An isolated tornado produced significant damage in central North Carolina during the afternoon of August 12<sup>th</sup>, well in advance of the remnants of Bonnie. Figure 6 contains pictures of some of the damage associated with the F1 Tornado that occurred at Spout Springs in Harnett County.



**Figure 6 Photograph of damage associated with the Spout Springs Tornado in Harnett county on August 12, 2004. Photos courtesy of Jeremy Meerscheidt (Spout Springs Fire Department).**

**Additional information on the August 12, 2004 Severe Thunderstorm and Tornado Event is available at...**

<http://www2.ncsu.edu/eos/service/pams/meas/sco/research/nws/cases/20040812/>

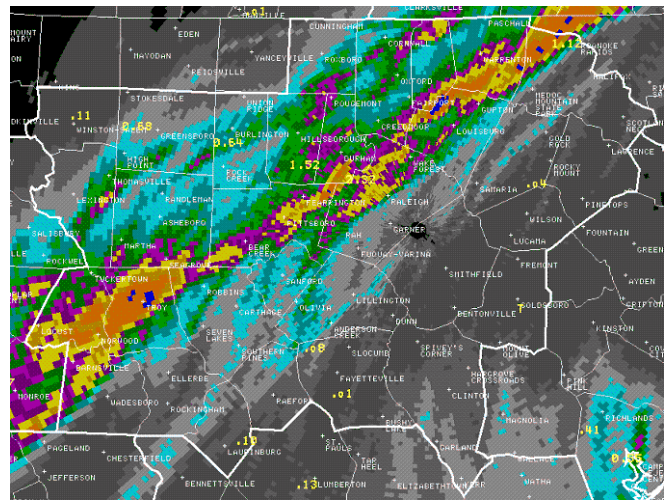
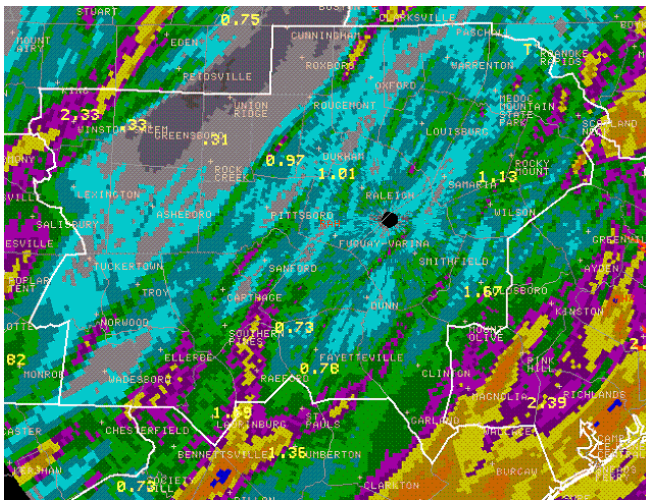
The remnants of Hurricane Bonnie, which had earlier made landfall along the Florida Panhandle, tracked northeast as a tropical depression across coastal North Carolina on August 13<sup>th</sup>. There were three tornadoes that developed in association with the remnant inner core of the depression that affected coastal North Carolina. These tornadoes hit portions of Onslow, Carteret, and Beaufort Counties during the pre-dawn hours. Very heavy rainfall also occurred in association with Bonnie's remnants.

**Additional information on the Tropical Depression Bonnie and the associated tornadoes and heavy rainfall is available at...**

<http://www.erh.noaa.gov/mhx/TDBonnie/TDBonnie.html>

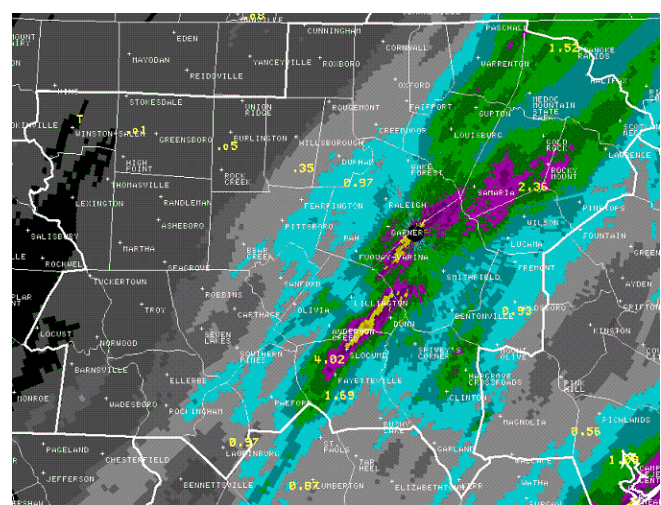
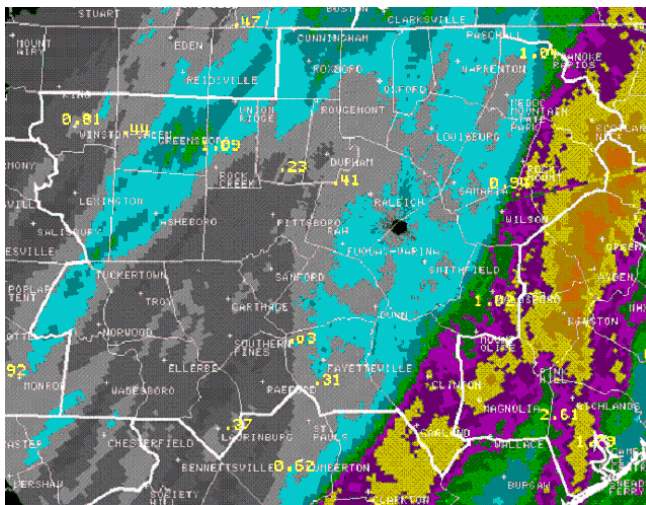
Bonnie's remnants were quickly followed by a greatly weakened Hurricane Charley, which was downgraded to a tropical storm on August 14<sup>th</sup> as it impacted eastern North Carolina. The peak wind gusts ranged between 30 mph and 60 mph, and heavy rain drenched eastern North Carolina once again. Figures 7 and 8 (on the next page) are Doppler Radar estimated rainfall amounts directly and indirectly associated with the remnants of Bonnie, ending August 13<sup>th</sup> and 14<sup>th</sup>, 2004. A cold front was moving into central North Carolina on August 12<sup>th</sup>, 2004. This front was the focus for strong and severe thunderstorms well in advance of Bonnie's remnants. The front likely combined with moisture associated with Bonnie to produce the heavy rainfall totals.





**Figures 7 and 8 Doppler Radar Estimated Rainfall Amounts Directly and Indirectly Associated with the Remnants of Bonnie, ending 800 AM, August 13<sup>th</sup> and 14<sup>th</sup>, 2004.**

Figures 9 and 10 are Doppler Radar estimated rainfall amounts directly and indirectly associated with the remnants of Charley, August 15 and August 16, 2004. Heavy rainfall fell in association with the remnants of Charley (Figure 9, Ending 800 AM, August 15<sup>th</sup>, 2004). However, the rainfall was not over. Additional heavy rainfall fell well after Charley had passed due to lingering moisture and a residual boundary over central North Carolina (Figure 10, Ending 800 AM, August 16, 2004).



**Figures 9 and 10 are Doppler Radar Estimated Rainfall Amounts Directly and Indirectly Associated with the Remnants of Charley, August 15 and August 16, 2004.**

Even after Alex, Bonnie, and Charley had unleashed their powers on North Carolina, the state was not finished with tropical systems. Tropical Storm Gaston formed over the Gulf Stream waters off South Carolina on August 29<sup>th</sup>. The system made landfall north of Charleston, S.C. as a tropical storm. The remnants spread heavy rain and gusty winds as it moved slowly northward across central North Carolina on August 30<sup>th</sup>. Rainfall once again produced some flash flooding, ranging between 2 and 5 inches across central North Carolina.

Figure 11 is a satellite image of Tropical Depression Gaston as it was centered near Raleigh at 1015 AM EDT, Monday, August 30, 2004. In addition to Gaston, Hurricane Frances can be seen approaching the Leeward Islands and Tropical Storm Hermine was sandwiched in between the two.

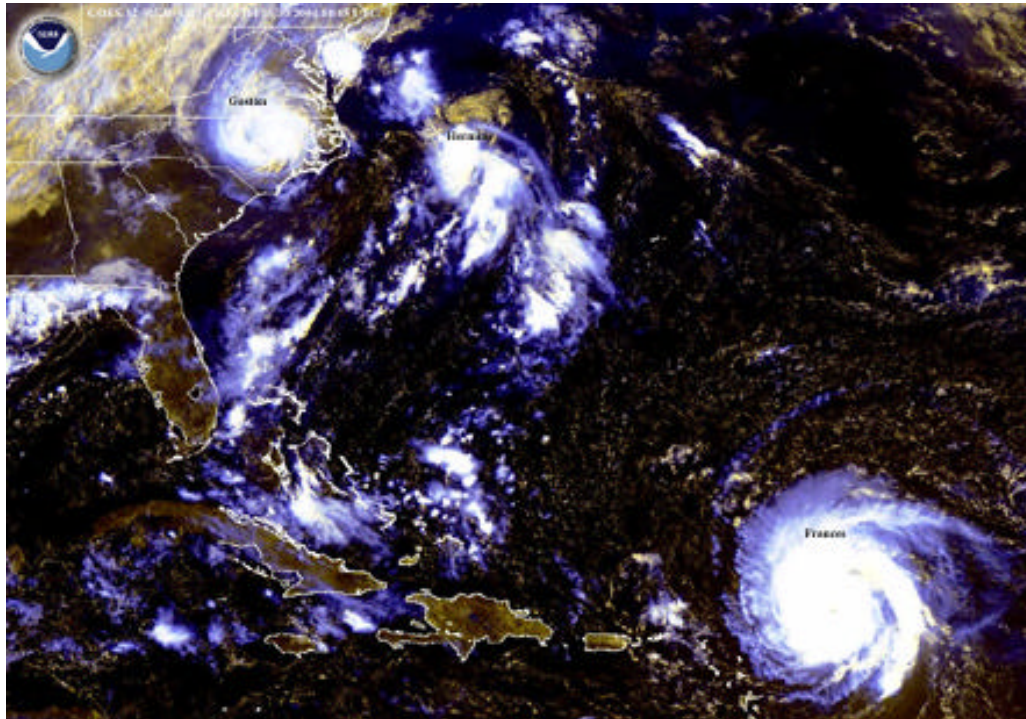


Figure 11 Satellite image of Tropical Depression Gaston, Tropical Storm Hermine, and Hurricane Frances at 1015 AM EDT on Monday, August 30, 2004.

Summaries of Alex, Charley, and Gaston can be found at...

<http://www.erh.noaa.gov/rah/events/>

## Current, Semi-Annual and Annual Precipitation Trends

Tropical rainfall in August had a significant impact on current rainfall trends across North Carolina. The 9.26 inches of rain recorded at Raleigh during August boosted the summer (June through August) rainfall total to 21.64 inches of rain, which is 10.15 inches above normal. This 3 month total, in part due to tropical rainfall in August, exceeds Greensboro's total for the entire year.

Raleigh began the first five months of 2004 with below normal precipitation. The tide turned in June, July, and August 2004, with three consecutive months of well above normal precipitation. This gives Raleigh a 2004 rainfall surplus of 5.07 inches. The annual (August 2003 through August 2004) precipitation total reached a net surplus of 9.74 inches.



Conversely, Greensboro largely missed out on August's tropical rain, recording only 2.1 inches of rainfall. Which was 1.61 inches below normal. Thus far in 2004, 9 of the 10 months have brought below normal rainfall to Greensboro. The semi-annual (January through August) precipitation at Greensboro only totaled 21.04 inches, 8.51 inches below normal. Conversely, in the past 12 months (September 2003 through August 2004), Greensboro has had a net precipitation surplus of 0.51 inches. However, this was a far cry from the 9.74 inch surplus seen on the eastern side of the Piedmont at Raleigh. Semi-annual and annual precipitation trends at Raleigh and Greensboro are shown in Figures 12 and 13 respectively.

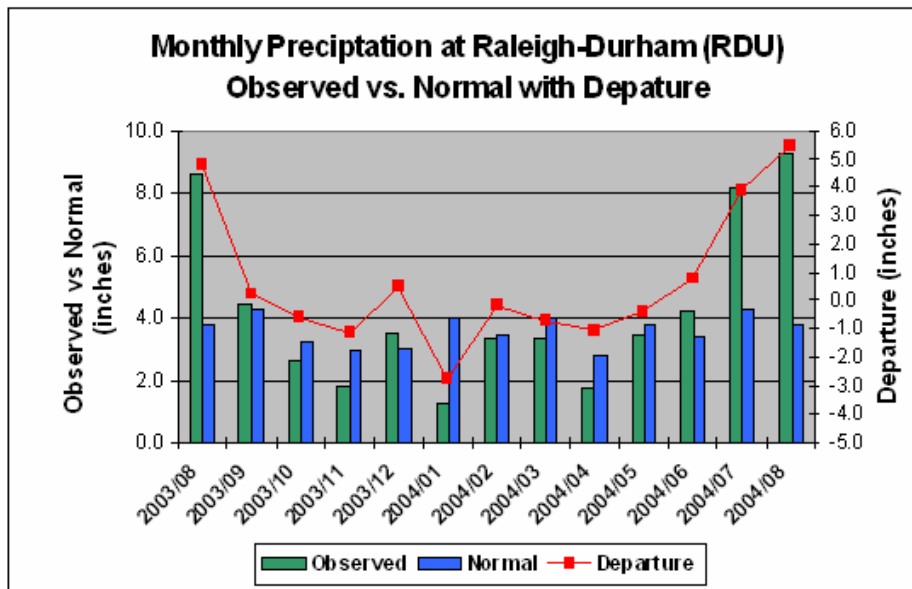


Figure 12 Semi-annual and Annual Precipitation Trends at Raleigh-Durham (RDU).

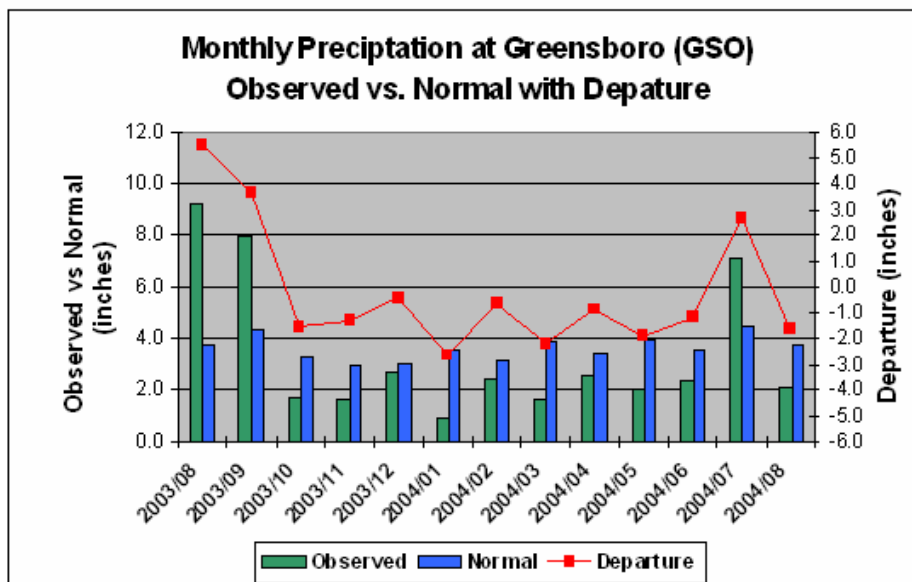


Figure 13 Semi-annual and Annual Precipitation Trends at Greensboro (GSO).



As depicted by the U.S. Drought Monitor on August 31, 2004, (Figure 12), there was no short-term drought, long-term drought, or ground water shortages in North Carolina. With saturated ground in some areas, there is a heightened concern of flooding especially if additional tropical systems affect the state in September or October.

The September 2004 Precipitation Outlook from the Climate Prediction Center, suggested an increased likelihood of above normal precipitation across the state. If this occurs, flooding may become a concern.

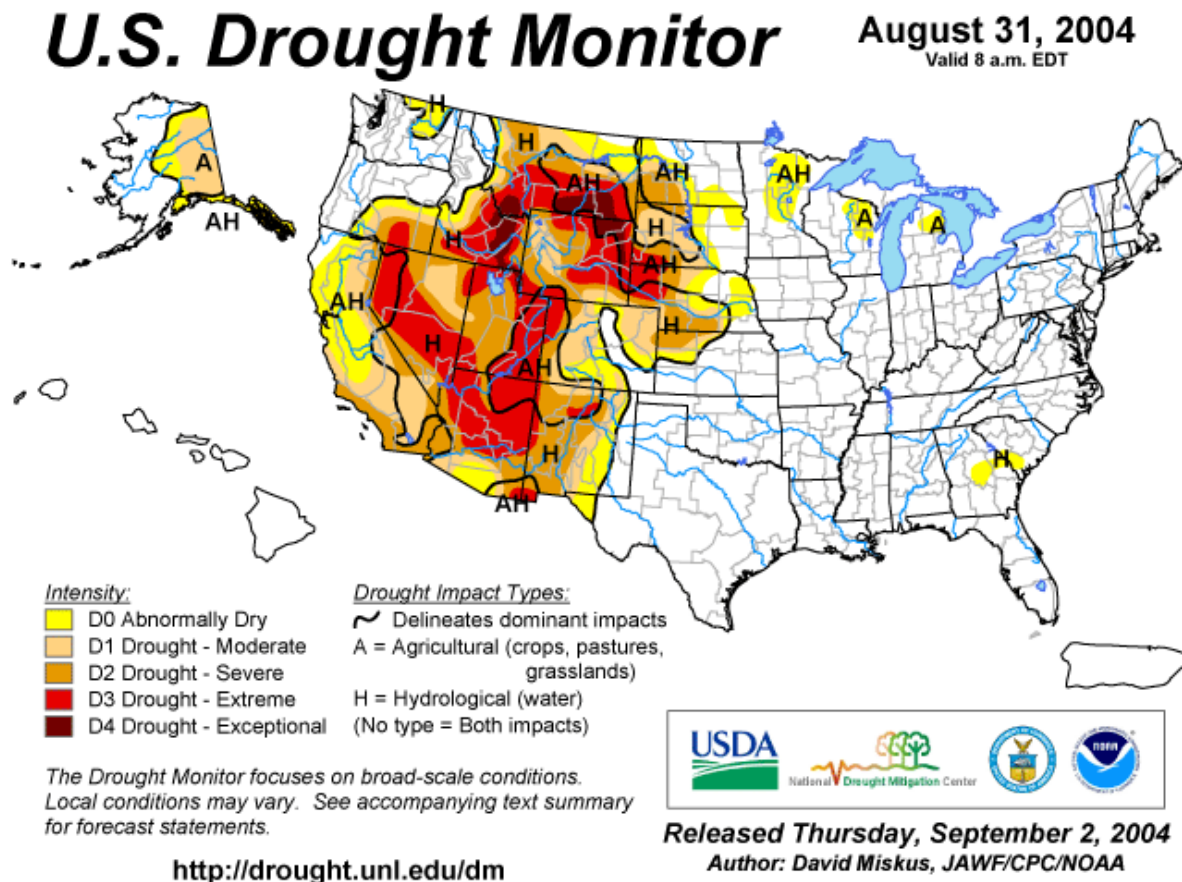


Figure 14 Drought is no longer an issue along the eastern seaboard according to the Drought Monitor.

## NC Weather Review Team

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Special thanks to Brandon Locklear and Michael Money Penny